Space Weather Technical Forecast

Issued on Friday 28 February 2025 at 12:36 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares. Decreasing risk of G1/Minor Geomagnetic Storms. Chance of Active fluence by Day 4 (03 Mar).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with occasional C-class flares. The peak flare was C9.3 at 27/2324 UTC from AR3998 in the southwest. There are now seven sunspot regions on the visible disc, with AR4004 and the new region in the NW both fading, and AR4000 no longer visible on the west limb. AR3998 in the southwest is rotating off the west limb, and because it can no longer be fully seen, it can't be assessed for any changes. AR4006 near north centre disc has been fading recently, losing area and simplifying. In the northeast, AR4009 has grown fairly rapidly and will be one to watch. The remaining spots are small and simple at present.

No Earth directed CMEs have been seen in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE/DSCOVR at L1, showed an increasing high speed stream connection with Ch19/+. Wind speeds were elevated, around 550 km/s, gradually increasing to strong near 750 km/s. Density was likely near average, although there are differences between ACE and DSCOVR. Interplanetary Magnetic Field, Bt, was moderate at 13nT or below. The north-south component, Bz, varied moderately between +11/-10nT. Phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Unsettled to Active (Kp 3-4) with a couple of G1/Minor geomagnetic storm (Kp 5) intervals after 28/0000 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was slightly above background levels, but well below the S1/Minor Radiation Storm level, on a declining trend. The high energy electron flux was at background levels. The 24-hour fluence was below the Active threshold (1e8 integrated pfu), recording 2.63e6 integrated pfu at 28/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Moderate, with a chance of isolated M-class flares. As AR3998 rotates well beyond the west limb over the next 24 hours or so, the risk of flaring reduces.

Solar Wind / Geomagnetic Activity: Glancing CME influence is possible but unlikely, with the main risk late Day 1 into Day 2 (28 Feb-01 Mar). Solar winds at Earth are currently strong, due to a

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high speed stream from CH19/+. During Days 3-4 (02-03 Mar), the solar wind is likely to decline to slightly elevated levels.

Unsettled to Active (Kp 3-4) geomagnetic activity is expected until Day 4, potentially with isolated G1-G2/Minor to Moderate geomagnetic storms (Kp 5-6), this most likely on Day 1 but with a declining risk through Days 2 and 3. By Day 4, geomagnetic activity is expected to decline to predominantly Quiet to Unsettled (Kp 2-3) levels.

Energetic Particles / Solar Radiation: High energy proton flux is likely to be at background levels. There remains a slight but declining chance of further enhancements, should any larger flares occur from AR3998. High energy electron flux is likely to increase during this period. The associated 24 hour fluence also has the potential to rise, with a chance of breaching the Active (1e8 integrated pfu) threshold by Day 4 (03 Mar).

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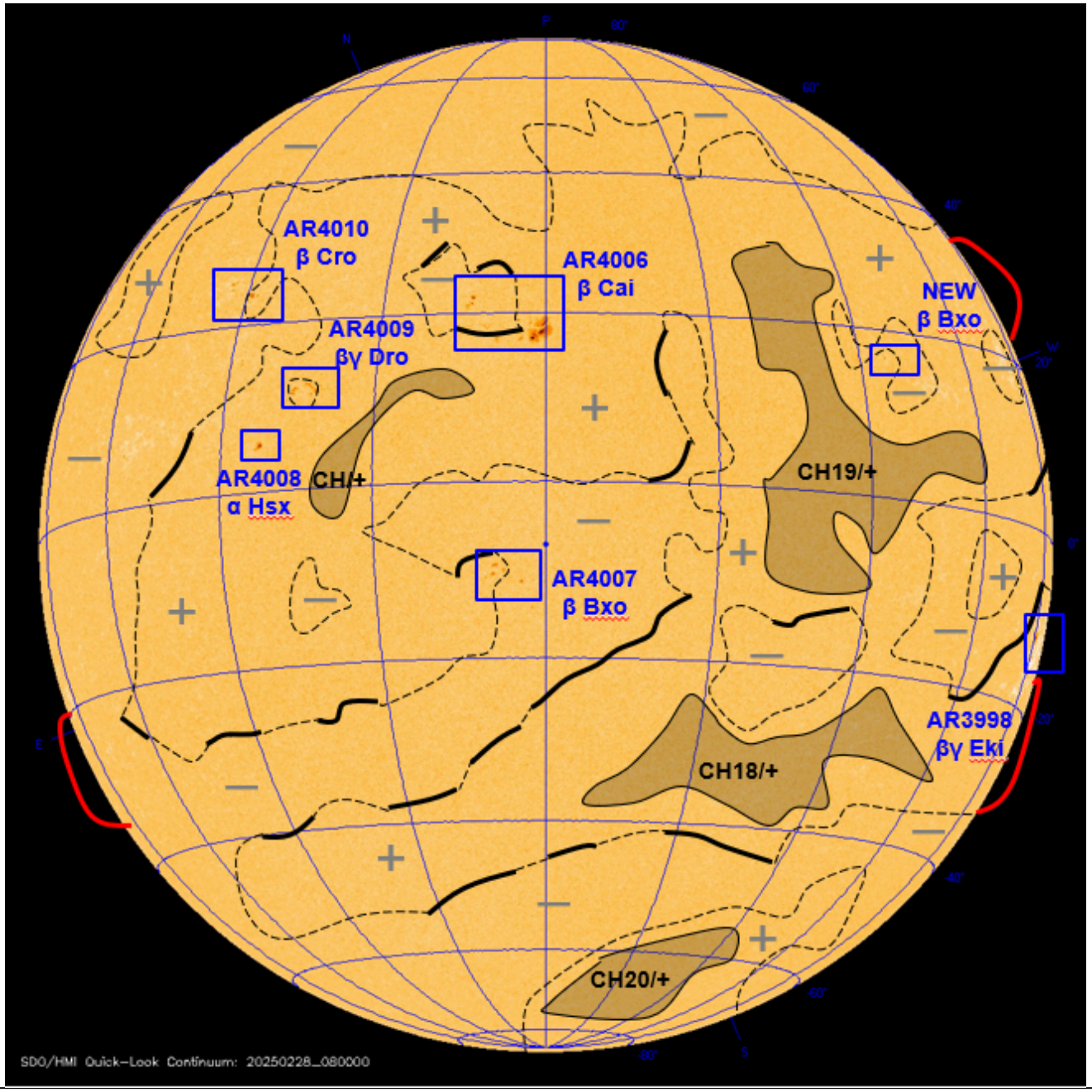
Figure 1: Solar synoptic map, valid 28/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

Several filament eruptions occurred on 24th-26th Feb, and although none are expected to be Earth directed weak glancing blows from one or more of the associated CMEs can't be ruled out for today, as indicated by a few of the members of MOSWOC Enlil ensemble. The main risk is probably later on Day 1 or perhaps more likely into Day 2 (28 Feb-01 Mar), after a re-assessment of the speed of one of the CMEs.

Solar winds at Earth are currently strong, due to a high speed stream from CH19/+. On the previous rotation of this persistent coronal hole the solar winds were elevated to strong through Days 1, 2 and 3 (28 Feb to 02 Mar). During Days 3-4 (02-03 Mar), the solar wind is likely to decline to slightly elevated levels. MOSWOC Enlil is thought to be giving reasonable guidance at this time.

Unsettled to Active (Kp 3-4) geomagnetic activity is expected until Day 4, potentially with isolated G1-G2/Minor to Moderate geomagnetic storms (Kp 5-6), this most likely on Day 1 but with a declining risk through Days 2 and 3. By Day 4, geomagnetic activity is expected to decline to predominantly Quiet to Unsettled (Kp 2-3) levels.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	60	40	20	5
Strong	G3	No	5	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Figure 2: Enlil ensemble, with a few members showing the potential for CME glances.

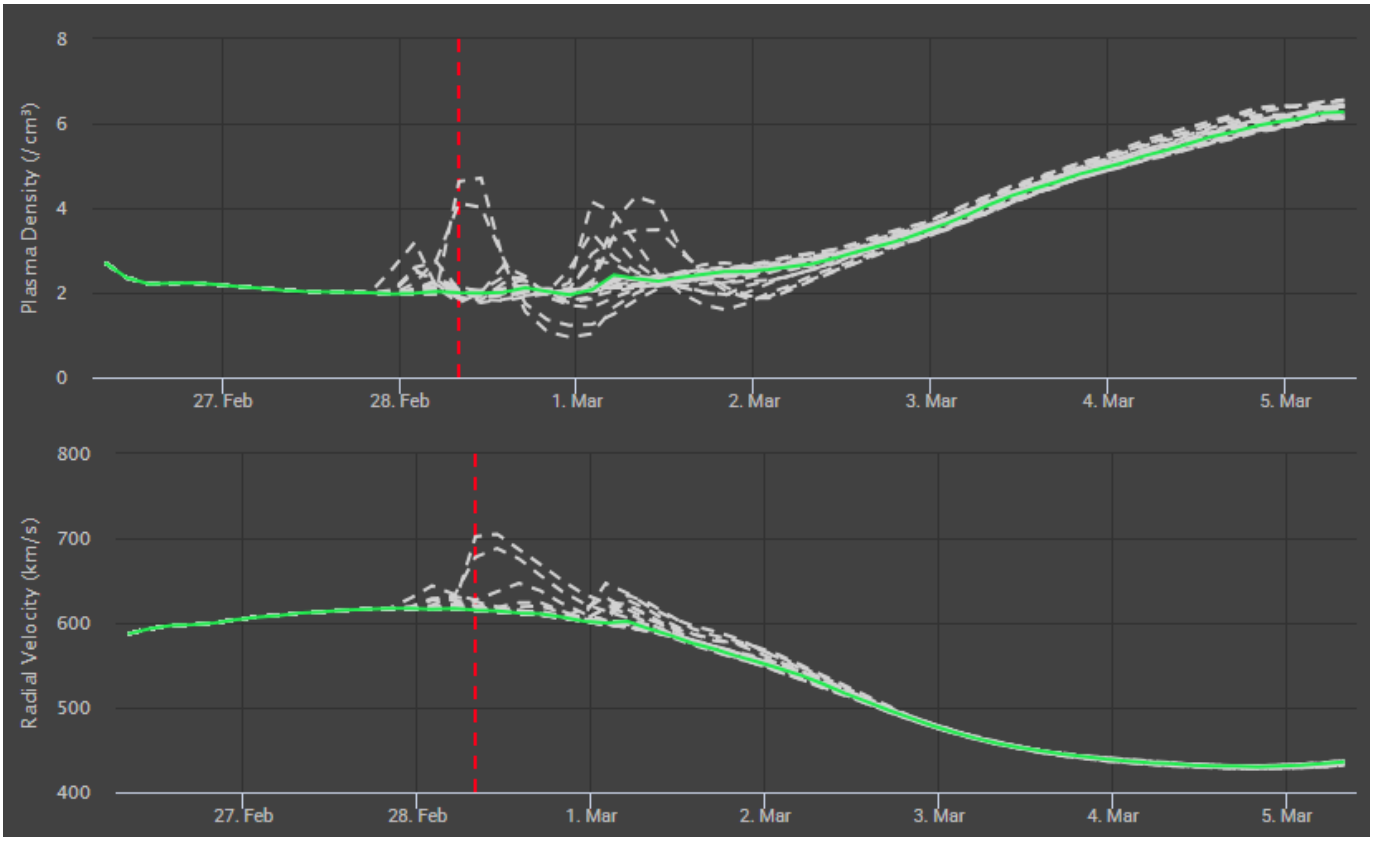

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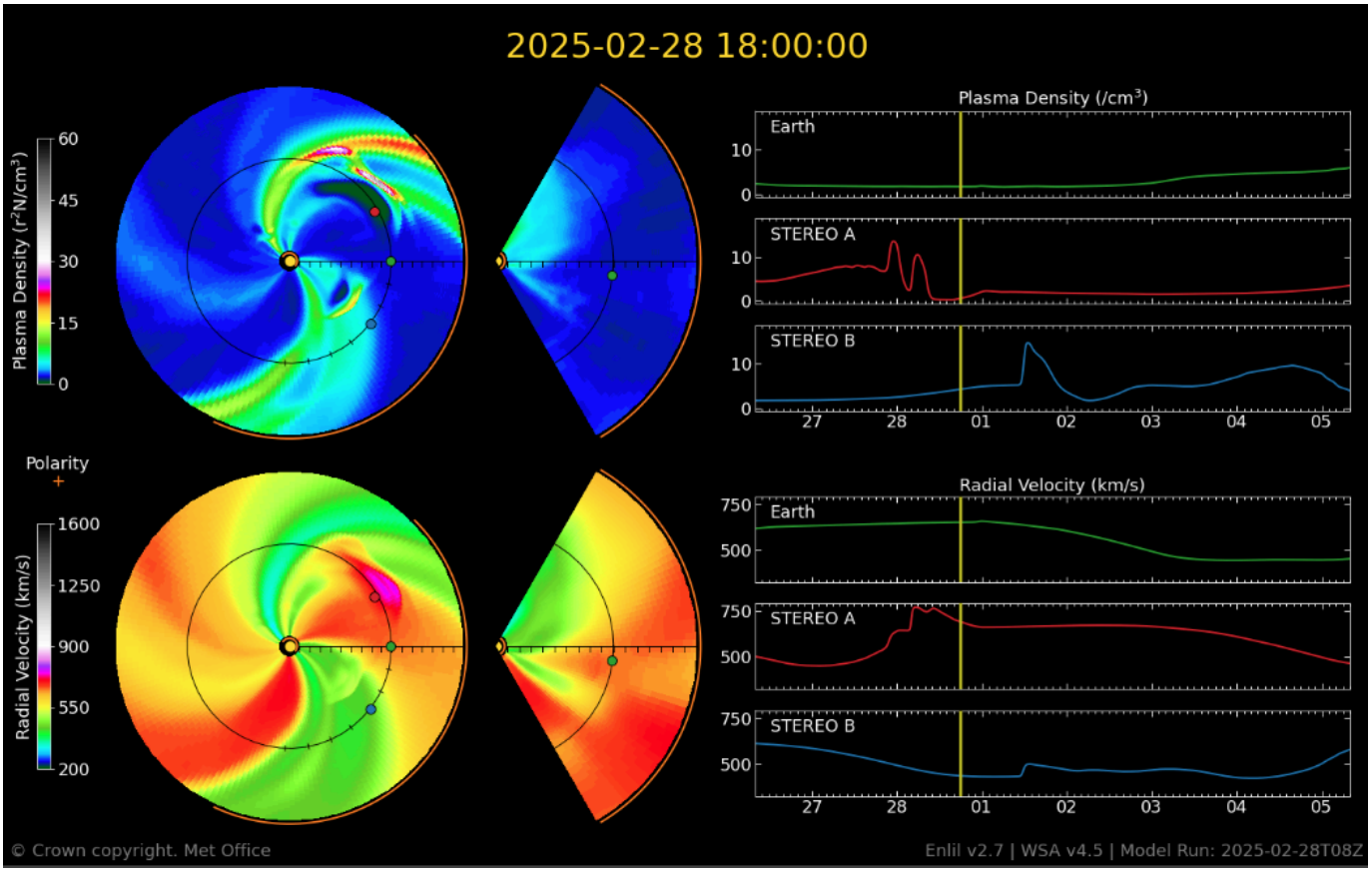
Figure 3: MOSWOC Enlil, showing CMEs passing both ahead of and behind Earth's orbit. Otherwise, Enlil is giving reasonable guidance with the wind speeds.



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Radio Blackouts - X-Ray Flares

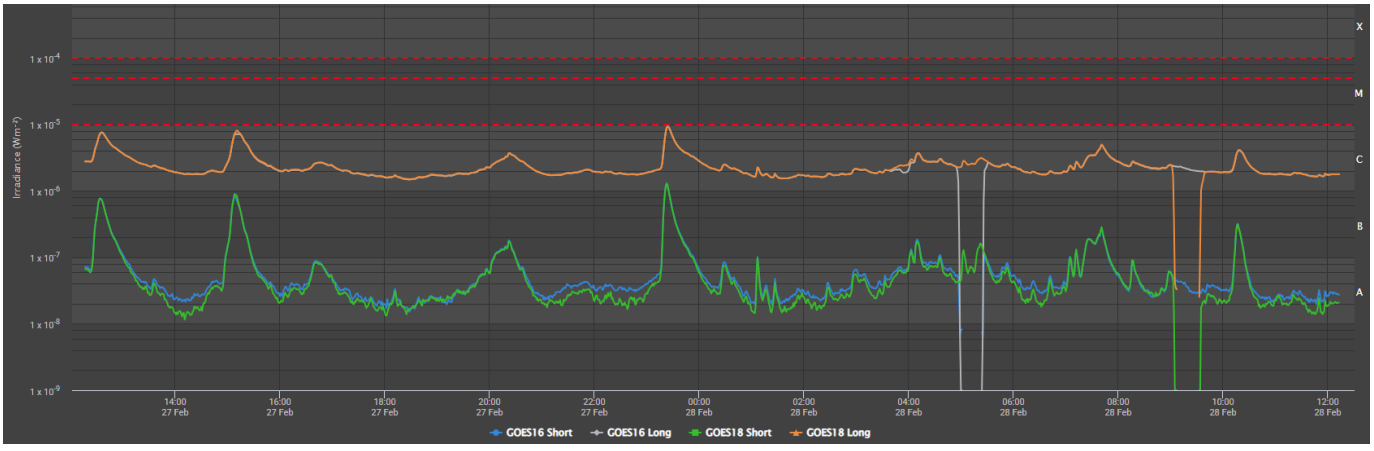
Solar activity has been Low with occasional C-class flares. The peak flare was C9.3 at 27/2324 UTC from AR3998 in the southwest.

There are now seven sunspot regions on the visible disc, with AR4004 and the new region in the NW both fading, and AR4000 no longer visible on the west limb. AR3998 in the southwest is rotating off the west limb, and because it can no longer be fully seen, it can't be assessed for any changes. AR4006 near north centre disc has been fading recently, losing area and simplifying. In the northeast, AR4009 has grown fairly rapidly so far and will be one to watch. The remaining spots are small and simple at present.

Solar activity is expected to be Low to Moderate, with a chance of isolated M-class flares. As AR3998 rotates well beyond the west limb over the next 24 hours or so, the risk of flaring reduces.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	50	40	30	30
Very Active	R3-R5 (X Class)	No	5	5	1	1

Figure 4: X-ray flux at GOES16 and 18, showing Low activity with C-class flares in the last 24 hours.



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Solar Radiation Storms (High Energy Protons)

GOES-18 high energy (>10MeV) proton flux has been steadily declining after the S1/Minor Radiation Storm that occurred on 25 Feb, and is now close to normal background levels. The most likely source of any further enhancement would be from AR3998 in the southwest, should it produce any large flares. This region is in the process of rotating off the west limb and will still present a reducing risk of proton enhancement until it is 2-3 days over the limb. As such the risk reduces slightly by Day 4 (03 Mar).

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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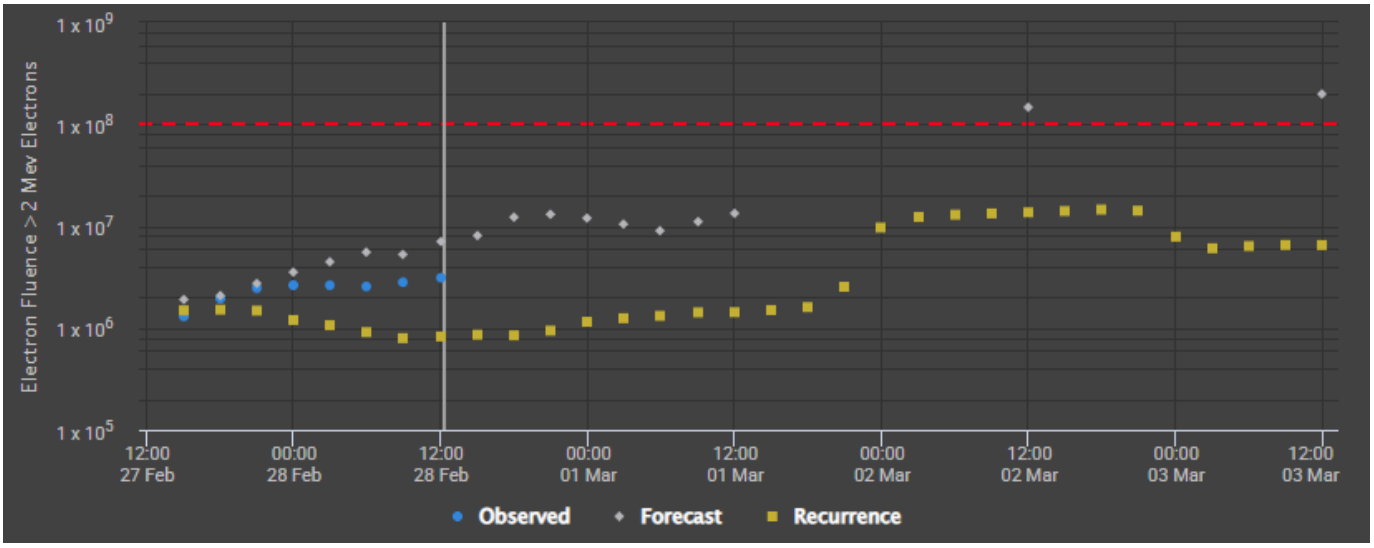
High Energy Electrons (≥ 2MeV)

The high energy electron flux (>2MeV), as observed at GOES-16, has been at mostly background levels. The current high speed stream from CH19 is giving strong wind speeds, similar to the previous rotation. However, it has also given stronger geomagnetic activity than the previous rotation, which suggests the possibility of greater charging of the Van Allen belts below GEO than previously. A general increasing trend is expected, especially later in the period when the HSS starts to decline, with the flux likely reaching high levels at the diurnal maximum during Days 3 and 4 (02 and 03 Mar).

The associated 24 hour fluence is currently below Active (1e8 integrated pfu), but is likely to show an increasing trend. MOSWOC REFM is currently indicating that the fluence will breach the Active level on Day 3, although it may be overdoing the forecast values. However the increasing trend is accepted, with an chance of Active fluence being reached by Day 4.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	5	20	40
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 5: MOSWOC REFM, which is forecasting fluence to go above the Active threshold. The upward trend is reasonable, however REFM is likely to be over estimating fluence values.



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